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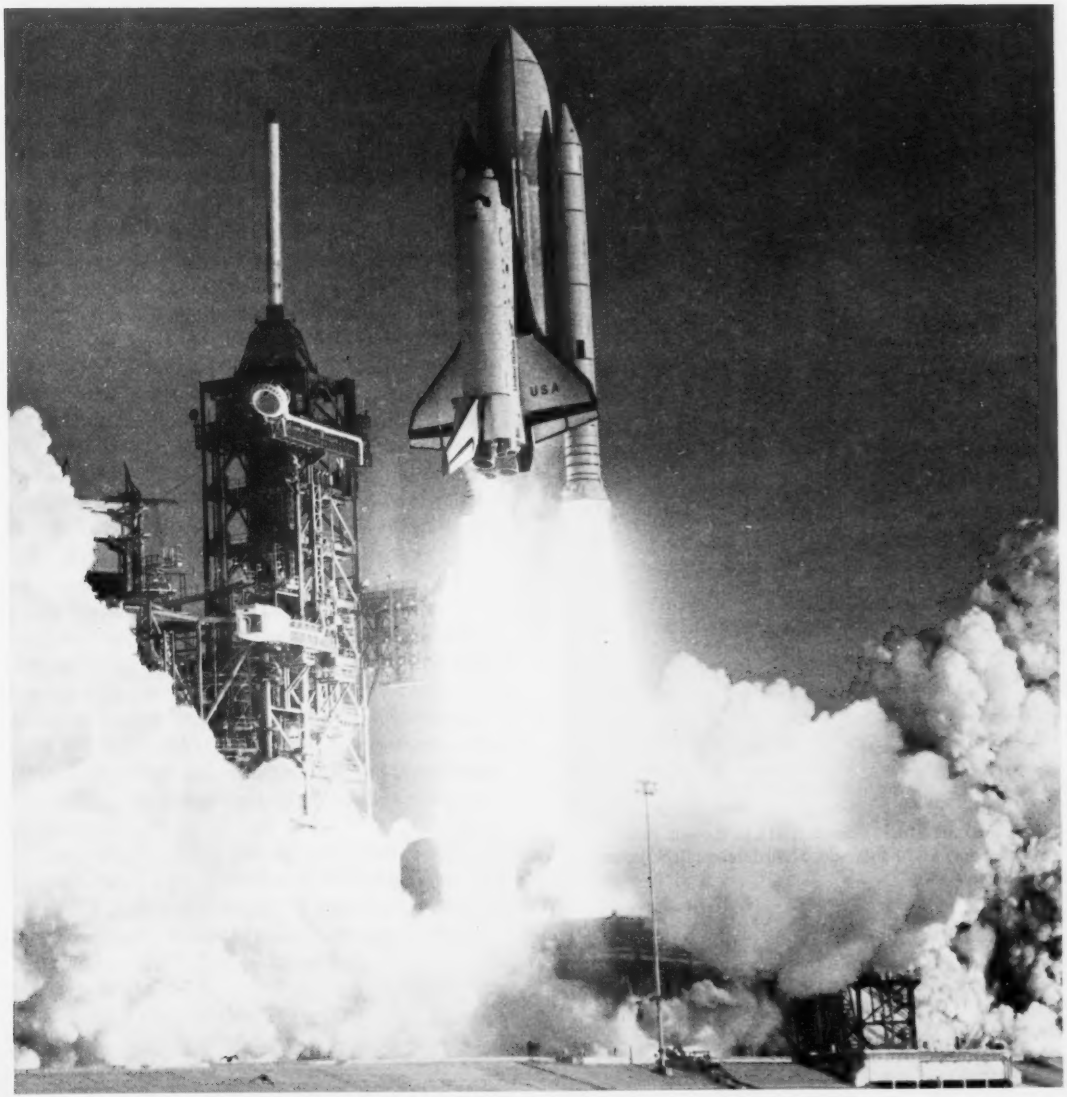

Cover

Columbia Liftoff—Launch of the first Space Shuttle, *Columbia,* Sunday, April 12, at 7:00 a.m. EST. The *Columbia's* crew, John Young (commander) and Bob Crippen (pilot) hailed this first reusable aerospace vehicle as "the world's greatest flying machine." The *Columbia's* 2½-day successful mission ended with touchdown on Rogers Dry Lake Bed, Edwards, Calif., on April 14 at 1:20 p.m. EST (see back cover).

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Letter from Washington

Dear Colleagues:

On Sunday, April 12, the eyes of the nation turned toward launch pad 39A at NASA's Kennedy Space Center to witness the launch of the world's first reusable manned space vehicle—the Space Shuttle *Columbia.* With this launch rested the promise of rebirth for the U.S. manned civilian space program, dormant since the Apollo-Soyuz Test Project in July 1975.

After years of dedication and hard work on the Space Transportation System, *Columbia,* the "gem of this new ocean—space," lifted off in a roaring fury of flame and smoke on April 12, and after two and one-half days of Earth orbit, touched down on Rogers Dry Lake runway at Edwards, Calif.

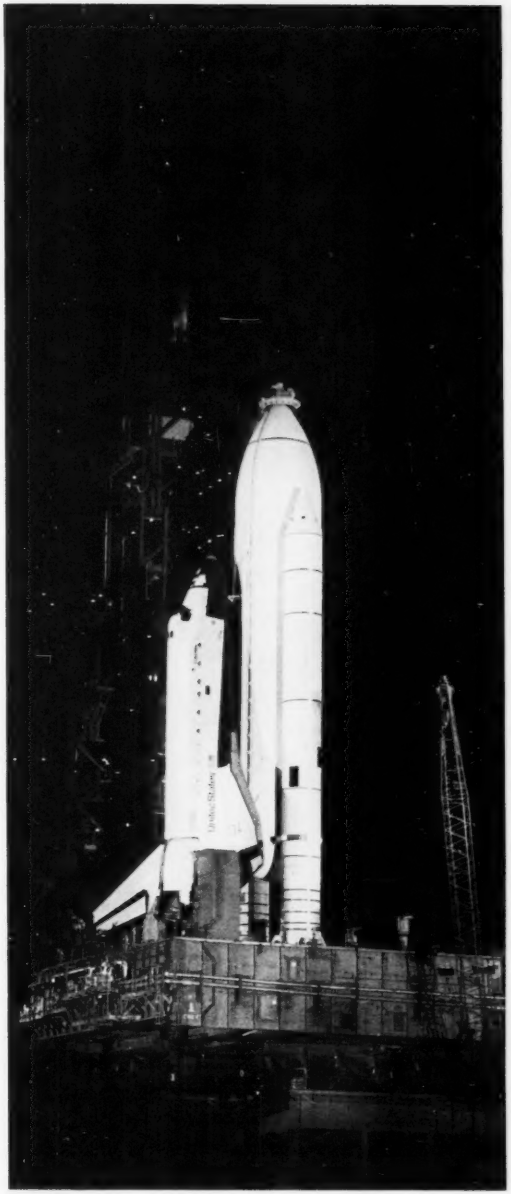
Columbia's crew commander, John Young, hailed this unique aerospace vehicle as the "world's greatest flying machine." Indeed, with this first orbital test flight, a new era of space transportation and utilization began. With the Space Shuttle, the concept of space travel has been revolutionized—we can enter space not just to explore, but to perform a variety of productive jobs.

The *Columbia* represents an achievement in aerospace technology and development never before realized in the history of manned space flight. I wish to extend my sincere appreciation and heart-felt thanks to each of you for your unswerving commitment and dedicated efforts toward achieving this new technology which will enable us to better understand and meet the challenges presented by the frontier of space.

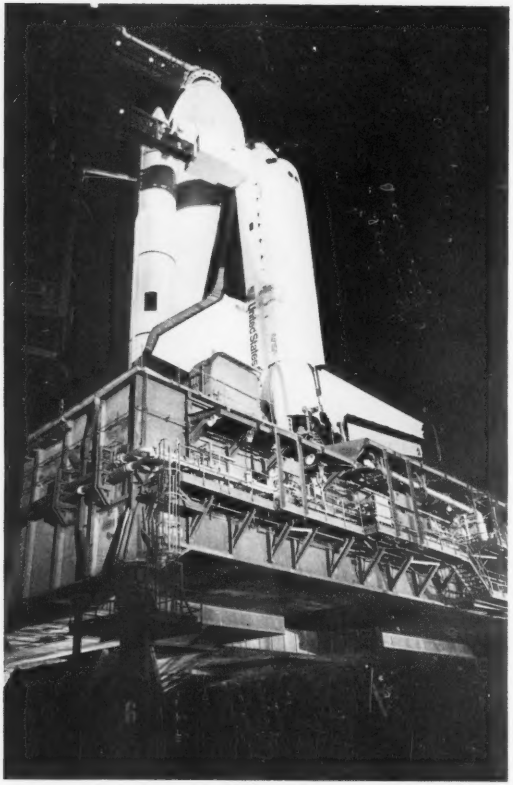
The era of the Space Shuttle will carve its own chapters in the annals of history. With your continued support, NASA will maintain its lead role in achieving new horizons in aeronautics and space, providing a better life for the people of this planet.

Sincerely,

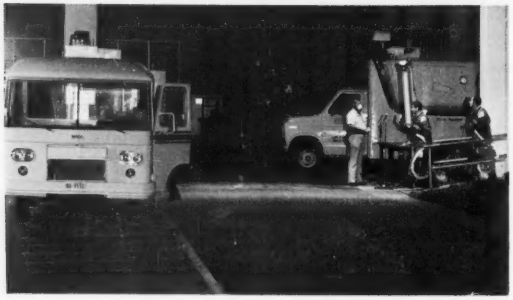
A. M Lovelace



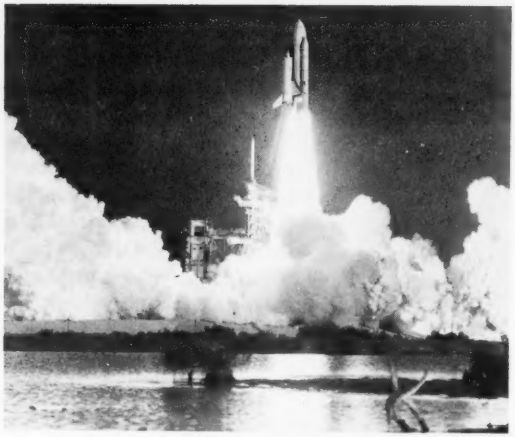
STS-1: First Space Shuttle Mission Photo Highlights



The *Columbia*, atop the Mobile Launcher Platform, after retraction of the Rotating Service Structure, on launch pad 39A at Kennedy Space Center, Fla.



The *Columbia*'s crew, John Young and Bob Crippen, leaving the Kennedy Space Center's Operations and Checkout Building for their 6-mile journey via NASA van to the launch pad on April 12.



Launch of the *Columbia*, Sunday, April 12, 7:00:03.983 a.m., EST.

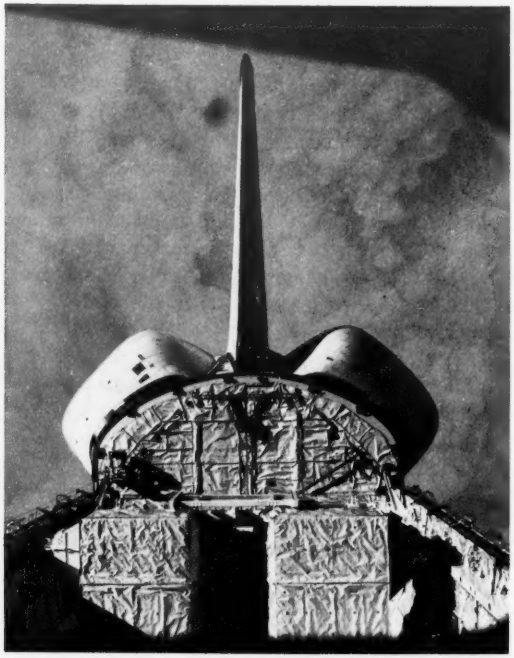
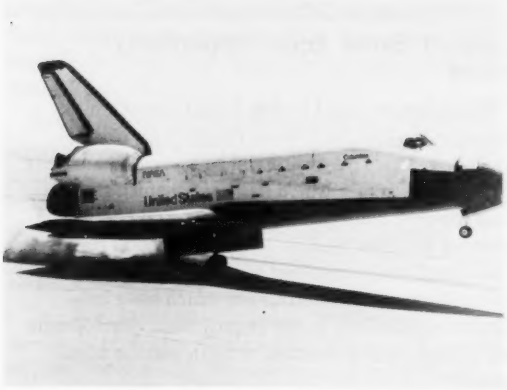
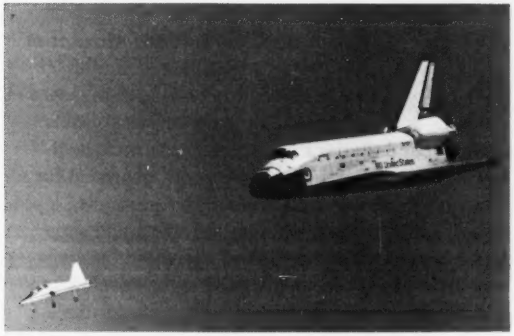


Photo from STS-1, taken with a handheld 70-mm camera, showing the cargo bay of the orbiter. This photo was taken during the first day of the mission, second orbit. The reported missing thermal protection system tiles located on the orbital maneuvering system pods are clearly shown.

Columbia pilot Bob Crippen shown changing a lithium hydroxide canister from the stowage compartment below the mid-deck of the Space Shuttle *Columbia*, during a television pass on the second day of the mission.



Touchdown of the *Columbia* at Edwards, Calif., April 14, 2 days, 6 hours, 20 minutes, 52 seconds Mission Elapsed Time; 1:20 p.m. EST.



The *Columbia* on its final approach to landing on Rogers Dry Lake Runway at Edwards, Calif. A NASA T-38 chase plane (lower left) accompanies the orbiter.

The *Columbia's* crew exit the orbiter after safing operations have been performed on the Edwards runway.

Goddard Earns Equal Opportunity Award

NASA has awarded its first Equal Opportunity Award to the Goddard Space Flight Center, Greenbelt, Md. This award will be presented annually to the NASA center which has implemented the most effective management strategies and has achieved the most positive affirmative action results.

Goddard was recognized for its "well planned and executed management strategies which have contributed significantly to the employment, development and utilization of minorities, women and the handicapped."

The innovative approaches to equal opportunity devised by Goddard management help sustain a high level of awareness among supervisory personnel of affirmative action goals. Continuing efforts are made by Goddard to recruit, train, promote and retain women, minorities and the handicapped and to provide them career growth opportunities.

In addition to such efforts, center management promotes the participation of women-owned and minority business enterprises in Goddard's prime contract and subcontract opportunities.

Goddard conducts several programs for junior and senior high school students to encourage them to enter scientific and engineering careers, ensuring a continuous flow of minority and female applicants for the future.

The Center's Cooperative Education Program provides college students an opportunity to alternate study with periods of work experience at the Center.

Other so-called "feeder programs" include: an office experience program in which students from high school vocational education classes gain on-the-job training experiences; an apprenticeship program for trade workers; a technician apprentice program; a summer program for graduate students in science and engineering; and a graduate research program.

Goddard's upward mobility programs offer professional and paraprofessional career opportunities to lower level employees.

The Center's outreach effort includes a research program for colleges and universities with predominant minority enrollments; a summer faculty research program; participation in the National Urban League's Black Executive Exchange Program; a Summer Institute in Computer Applications for college students; and an on-site training program for area students in Special Education curricula.

Goddard's Equal Opportunity Program was judged best of all NASA centers after a detailed screening process conducted by NASA's Office of Equal Opportunity Programs and Equal Opportunity Council. The name of the nominated center was submitted to NASA's Incentive Awards Board which, in turn, submitted it to the NASA Administrator for approval.

Lee to Head Langley Equal Opportunity Office

Robert B. Lee has been selected to head the Office of Equal Opportunity Programs at NASA's Langley Research Center, Hampton, Va.

He is former manager of the Limb Infrared Monitor of the Stratosphere/Nimbus 7 Satellite Correlative Measurements Program, responsible for conducting studies to assess the performance of air pollution measurement instruments, proposed for use by the Environmental Protection Agency, National Oceanic and Atmospheric Administration and state environmental quality regulatory agencies. Since last October he has also been involved in the development of the Correlative Measurements Program for the HALOE Space Shuttle experiment.

As head of the Office of Equal Opportunity Programs, Lee will be responsible for monitoring and coordinating the center's Equal Opportunity Programs, including the Affirmative Action Plan, Hispanic Employment Program and Federal Women's Program, and for administering the Discrimination Complaints System.

Lee began his NASA career in 1964 as a cooperative training student. In 1965 he joined Langley's professional staff, conducting research in material science and space optics. From 1971 to 1974 he was project manager for a stratospheric ozone determination program using photometry of eclipsing satellites. In 1974 he was named data acquisition manager for the Dual Air Density Explorer Satellites Project and was an analyst for the West German ESRO IV Satellite Program.

Jones Receives President's Award

Robert Thomas Jones, senior scientist at NASA's Ames Research Center, was presented the President's Award for Distinguished Federal Civilian Service on March 13 at Ames.

Jones discovered the theory of the "simple sweepback," one of the most important discoveries in aerodynamics (swept wings are seen on most jet aircraft today) and is an internationally acclaimed expert on aerodynamics, optics and biomechanics.

The President's Award medal and certificate, the highest honors given by the Federal government to a career employee, are awarded for outstanding achievements which "exemplify, to an exceptional degree, imagination, courage and high ability in carrying out the mission of the government." The award is given to no more than five persons each year. Prior NASA recipients include Wernher von Braun, Hugh L. Dryden, Robert R. Gilruth, Homer E. Newell and William H. Phillips.

Jones was selected for the award by former President Jimmy Carter. In 40 years of government service, his many contributions include the narrow, triangular wing, the independence principle for three-dimensional boundary layers and the concept of the oblique (yawed) wing for supersonic aircraft.

Jones, who never finished college, was awarded an honorary doctorate of science in 1971 by the University of Colorado for his "scientific eminence and his service to society."

Jones' career with NASA began in 1932, when he went to work on a nine-month Public Works Administration assignment at NACA's Langley Memorial Aeronautical Laboratory (now NASA's Langley Research Center) in Hampton, Va.

He stayed on at Langley, and by World War II had published important papers and become well-known in aeronautical circles. Jones's 1944 discovery of the sweepback theory was not accepted by most scientists at the time, but NACA began experiments to test the theory. When the Allies defeated Germany, U.S. scientists discovered the Germans knew about the effect of sweep and were incorporating it in new aircraft designs.

For his discovery of the sweep effect and other contributions, Jones was given the Sylvanus Albert Reed Award by the Institute of the Aeronautical Sciences in 1946. That same year, he came to work for Ames Research Center.

In 1963, Jones left NASA to work for AVCO Everett Research Laboratory, where he applied fluid dynamics to the problems of blood flow. Returning to Ames in 1970, he went back to work on his oblique wing concept. An oblique wing research aircraft now is being tested at NASA's Dryden Flight Research Center, Edwards, Calif.

In 1973, Jones was elected to the National Academy of Engineering and the American Academy of Arts and Sciences. He was honored in 1976 with a cash award from NASA's Inventions and Contributions Board and received the Prandtl Ring Award in 1978 from the German aeronautics society (Deutsche Gesellschaft fur Luftund Raumfahrt), considered the highest honor in the field of fluid dynamics. A Fellow of the American Institute of Aeronautics and Astronautics, Jones in 1979 was chosen for the award of Honorary Fellow.

Ames Director Elected to Engineering Academy

Clarence A. Syvertson, Director of NASA's Ames Research Center, Mountain View, Calif., has been elected to the National Academy of Engineering. Election to the Academy is considered the highest professional distinction to be conferred on an engineer.

Syvertson, who earned his bachelor of aeronautical engineering and master of science degrees from the University of Minnesota, was cited for "outstanding contributions in aerospace engineering, sound guidance of research and technology programs and innovative institutional guidance."

The Academy, with 1,075 members in the United States and 93 foreign associates, honors those who make important contributions to engineering theory and practice or who demonstrate unusual accomplishments in the pioneering of new and developing fields of technology.

Syvertson became Director of Ames Research Center in April 1978. He was Deputy Director from 1969 until August 1977, when he was named Acting Director. He has been with Ames since 1948, when he came to work for the National Advisory Committee for Aeronautics (NACA—NASA's predecessor) as research scientist and assistant branch chief.

Syvertson became Chief of the 3.5-foot Hypersonic Wind Tunnel Branch in 1959. From 1963 to 1966, he was Director of the Mission Analysis Division. In 1966, he was named Ames Director of Astronautics, a position he held until he was appointed Deputy Director in February 1969.

Syvertson received the NASA Exceptional Service Medal in 1971 for his work as Executive Director of the Joint Department of Transportation–NASA Civil Aviation Research and Development Policy Study. He served in that position while on a year-long detail with the Transportation Department in Washington, D.C., from 1970–71.

Earlier awards include the Lawrence Sperry Award from the American Institute of Aeronautics and Astronautics and the Space Act Invention Award (shared with three others). He was named a Fellow of the American Institute of Aeronautics and Astronautics in 1976 and a Fellow of the American Astronautical Society in 1978. In 1977, Syvertson completed the Advanced Management Program of Harvard Business School.

Marshall Tests Yield Record Battery Life

Two batteries being tested at NASA's Marshall Space Flight Center, Huntsville, Ala., to determine their useful lifetimes under simulated Earth-orbital environment and operation recently ceased to function at full capacity after a record eight years and two months.

A total of 44,213 Earth-orbit cycles were simulated in a thermal-vacuum chamber during the entire period of life-testing performed on the nickel-cadmium batteries, plus associated equipment including a charger and regulator, by the Center's Electronics and Control Laboratory.

The units—of the type originally used on the Skylab space station's Apollo Telescope Mount, and known as Charger Battery Regulator Modules—were operated in orbital cycling modes simulating the sunshine-darkness cycles of Skylab, Space Telescope and the 25 kw power system.

"As far as we are able to ascertain," said Roy Lanier, who participated in the tests, "these batteries have survived longer under simulated Earth-orbit operation than any others in existence."

Upon termination of the testing in mid-December, the batteries—each containing 24 cells—were opened and selected cells were turned over to the Marshall Center's Materials and Processing Laboratory for dissection and analysis. "This analysis should provide valuable insight into cell degradation and failure mechanisms," Lanier said. "Methods of increasing cell life also may be identified."

The associated electronics, both charger and regulator, functioned throughout the test period without a failure of any type, Lanier reported. "The batteries themselves exhibited several anomalies beginning as early as seven months after test initiation, when they underwent the same loss of capacity experienced in the Skylab mission," he said. "However, the test units were reconditioned remotely, using our Marshall-developed battery protection and reconditioning circuit, and continued to supply the simulated loads until the test was terminated."

Even though several cell anomalies (capacity loss, internal cell leakage and intermittent shorts) occurred during the test period, use of the circuit allowed the cells to recover and continue to function.

The first cell failure occurred in October 1978, after six years of operation and 32,000 simulated Earth-orbital cycles. Even then, the units continued to operate at full load with the reconditioning circuit connected.

Only after 41,000 orbits and seven and one-half years of operation, when a third cell shorted in one of the batteries, was it not possible to continue to support the full load.

NASA Enters Paris Air Show

The annual Paris Air Show is expected to attract almost a million people between June 4 and June 14, most of whom will visit the United States pavillion and view the NASA exhibit.

This exhibit will occupy 3,500 square feet, about one-quarter of the pavillion. As in the past, it will be the only thematic exhibit representing the U.S. government; the rest of the pavillion will be devoted

to displays by aerospace business and industry representatives.

The theme of NASA's exhibit this year is "Imagination: the Essential Element." Built around this theme will be several major modules dealing with our nation's heritage of accomplishment in air and space, aeronautics, the Space Shuttle, space sciences and applications of aerospace technology. Plans call for demonstration flights of two of NASA's experimental aircraft, the XV-15, and the QSRA (Quiet Short-Haul Research aircraft).

Highlights of the exhibit will be a full-scale mock-up of the Space Shuttle Orbiter flight deck, 1:10 scale models of Galileo and Voyager, and a multi-image, mixed media presentation tracing the history of flight since the kite was invented in China some 2,400 years ago. The entire exhibit will be supplemented by slides, films, videotapes and brochures.

A feature of this year's air show will be a pre-show international symposium scheduled for June 2 and 3. The symposium is the first of its kind to be conducted in connection with the show. It is being organized by the American Institute of Aeronautics and Astronautics. The NASA Administrator is expected to participate along with several international authorities, who will discuss a range of issues, including aerospace policy, aircraft development, space science and applications and the future of the aerospace industry.

Marshall Recovering Critical Metals

Many laboratories at NASA's Marshall Space Flight Center, Huntsville, Ala., use gold and a variety of other precious metals for various applications. Gold, silver, platinum, iridium, osmium, rhodium, and ruthenium sometimes are used for electrical contacts or electroplating for corrosion protection. When the usefulness of these metals to the labs is ended, Marshall's Property Management Division recovers much of it for reuse.

The General Services Administration and the Department of Defense operate a government-wide program to see that these metals are conserved, recovered where feasible and transferred to a national defense stockpile.

Before valuable metals can be recycled at Marshall, the center's Property Management Division must determine whether or not they can be recovered

A technician at the Marshall Center's Photo Lab adjusts the amperage on electrolysis equipment used to recover silver from photographic developing solutions.

profitably. Some Marshall organizations have been "banking" silver recovered from X-ray film and developing solutions for some time. The Photo Lab and Documentation Repository are big contributors because of the amount of film processed. The Marshall Medical Center also turns in silver recovered from X-ray film developing solutions and scrap X-ray film itself.

The materials recovered are sent to a federal precious metal "bank" at Colts Neck, N.J., where it is further processed and credited to NASA's account. Last fiscal year, 324 troy ounces of silver-bearing photo processing residue, and 2,400 pounds of scrap film, were recovered at Marshall and shipped to the "bank." Assuming a 90 percent recovery from the residue and the two percent-by-weight recovery rate for film cited by Precious Metals Recovery Program officials, Marshall's silver yield alone last year would be worth about $30,000 at today's prices.

Spacelab Components Undergo Integration Testing At Marshall

Components for Spacelab 1's Atmospheric Emission Photometric Imaging (AEPI) experiments are undergoing integration testing at NASA's Marshall Space Flight Center Space Sciences Laboratory.

Design and construction of the components was divided between the Marshall Center and Lockheed Palo Alto Research Laboratory, Calif. The Lockheed

detector array, aperture door and camera controller for the AEPI experiment were delivered in February for integration with the Marshall-built pointing and command data management assemblies.

The AEPI experiment has five major objectives: to investigate the ionospheric transport processes; support magnetospheric electron bounce experiments; measure electron cross sections for selected atmospheric species; detect small particle contamination and perform pilot studies of natural auroras.

Ionospheric transport processes involve global patterns of electric fields and neutral winds. Knowledge of ion motion is important in understanding the cause-effect relationship on upper atmospheric dynamics.

Support of magnetospheric electron bounce experiments is a prime objective of the low-light-level television (LLLTV) system of the AEPI experiment. Particle and plasma accelerators on Spacelab 1 will fire particle beams into the magnetosphere to study interactions leading to artificial aurora and wave generation, and to determine particle trajectories for field tracing and measurement of magnetospheric electric fields. Success of such a program is the ability to detect the low-light-level spots that will identify spatial and temporal beam interactions with the ionosphere.

Measurement of several electron impact cross sections of atmospheric constituents is the objective of AEPI's "induced equatorial aurora" experiment. The experiment involves the ejection of an electron pulse on a magnetic equatorial crossing by the Orbiter and viewing the emission returning from the beam path with the AEPI instruments from the Spacelab.

One of the major concerns in the use of the Space Transportation System (STS) for astronomical observation is the possible presence of small particles in the vicinity of the spacecraft. The LLLTV will monitor the environment of the STS by directly observing the scattered light due to small particles.

Principal investigator for the experiments is Dr. S. B. Mende of Lockheed Palo Alto Research Laboratory. Co-investigators include Dr. R. H. Eather, Boston College, Chestnut Hill, Mass.; Doctors R. J. Naumann, D. L. Reasoner, and G. R. Swenson all of Marshall's Space Sciences Lab; and K. S. Clifton and B. J. Duncan, also of Marshall's Space Sciences Lab.

Dynamics Explorer Twin Spacecraft Under Evaluation Tests

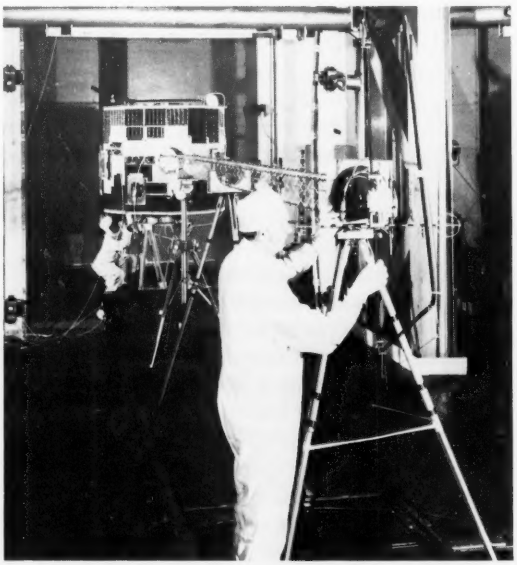
Two spacecraft that will ride piggy-back into orbit next July are currently undergoing rigorous prelaunch testing at the Goddard Space Flight Center, Greenbelt, Md.

Called Dynamics Explorer (DE) -A and -B, the twin satellites are scheuled to be stacked together and placed into coplanar polar orbits by a Delta 3913 launch vehicle from the Western Space and Missile Center, Lompoc, Calif., on July 31.

Their mission will be to explore the boundary region between Earth and space that affects the atmosphere, auroral displays, radio transmissions and perhaps climate and weather.

Solar radiation and the solar wind have a dynamic impact on the near Earth environment, the result of which affects the state of the atmosphere, ionosphere, magnetosphere and the most familiar phenomena—weather, auroral displays and radio disturbances.

Prior spacecraft such as the Atmospheric Explorers have provided new information on solar radiation upon the lower thermosphere and upper atmosphere. The ISEE (International Sun-Earth Explorer) program has provided additional new information on interactions between the solar wind



Dynamics Explorer-A shown here undergoing preflight evaluation testing in the Magnetic Test Facility at NASA's Goddard Space Flight Center, Greenbelt, Md.

and the Earth's magnetic field; however, adequate knowledge does not exist regarding interactions between the two regions.

The Dynamic Explorer program is designed to supply such knowledge—specifically, the strong interaction processes coupling the hot, tenuous, convecting plasmas of the magnetosphere and the cooler, denser plasmas and gases co-rotating in Earth's ionosphere, upper atmosphere and plasmasphere.

To accomplish this, the project will provide a central data processing and analysis system available so that each investigator on the science team can display geophysical data from all spacecraft instruments.

In their polar, coplanar orbits, one satellite (DE-B) will have a perigee sufficiently low (305 kilometers) for neutral composition, temperature and wind measurements. Its apogee will be sufficiently high (1,300 km) to provide a lifetime greater than one and one-half years and to allow measurements above the interactive regions for superthermal ions and plasma flow measurements of the magnetospheric field lines.

The second spacecraft (DE-A) will be placed into a highly elliptical orbit having an apogee of 24,875 km to allow for global auroral imaging, wave measurements in the middle of the magnetosphere and crossings of auroral field lines at several Earth radii.

The DEB (low mission) has six flexible stem antennas 10 meters long, and a single rigid boom 6 meters long. These external antennas will collect data for the scientific instruments on board.

The solar cell arrays mounted on the 136-m diameter spacecraft body will supply the satellite with electrical energy which can be delivered directly to the scientific instruments or stored in nickel-cadmium batteries as required.

DE-A is spin stabilized; its pitch, or spin axis having a spin rate of 10 rpm while the DE-B spacecraft is three axis stabilized with its pitch axis controlled to continually point towards the Earth's surface. Configurations of both spacecraft are designed to minimize unbalancing torques created by atmospheric drag encountered in space.

Tracking, command, real-time and recorded data will be provided by NASA's Space Tracking and Data Network; the NASA Worldwide Communications System, NASCOM; and the DE Operations Control Center at Goddard.

Venus Cloud Studies Show Changes in Long-Term Wind Patterns

Significant discoveries concerning the pattern of atmospheric changes on Venus have been made based on two years' worth of Pioneer orbiter observations. The discoveries indicate a long-term period of change for both the planet's wind patterns and for the existence of a haze layer above the cloud tops.

The Pioneer orbiter has taken about 1,000 pictures of Venus clouds and extensive measurements of the particles composing those clouds.

The most noteworthy of the discoveries is that Venus' planet-wide wind patterns change dramatically over a period of several years. Two patterns have been discerned: a mid-latitude jet-stream pattern and a cloud-and-wind pattern which acts like a solid body.

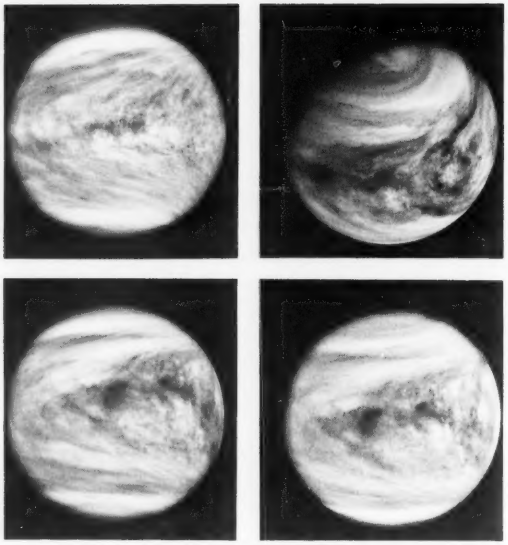
A second discovery shows that the high-altitude haze layer which completely envelops Venus' clouds appears and disappears over several-year periods. This haze is a "smog layer" extending above the main cloud region by about 30 kilometers. This altitude on the Earth would be well into our stratosphere.

The Pioneer Venus orbiter is expected to return pictures and other data until 1985. The orbiter reached Venus in December 1978, and the four Pioneer probe craft entered the atmosphere at the same time. Cloud pictures and polarimetry data are provided by the cloud photopolarimeter. Dr. Larry Travis, NASA Goddard Institute for Space Studies, New York City, is principal investigator.

The two new discoveries of a multi-year change in the pattern of global winds, and similar changes in the planet-wrapping haze layer could help explain the major remaining mystery of Venus' atmosphere: Why, on a planet which has almost no axial rotation, do the upper level winds circle the planet at tremendous speeds of 360 kilometers per hour? These winds cover the planet completely, blowing at virtually every latitude from equator to pole. Their speeds can be determined from the speeds at which the clouds, carried by the winds, travel around the planet.

Wind speed measurements from top to bottom of the atmosphere by the four Pioneer probe craft show that these high-speed, cloud-level winds are coupled to lower-altitude winds, which also have very high speeds.

The 360-km/hr cloud-level winds blow around the planet at an altitude of 65 km. Wind speeds then range down to 192 km/hr at a 50-km altitude and to



Ultraviolet photos of Venus' clouds taken by the Pioneer Venus spacecraft during the past two years which show a variety of cloud formations.

a still-very-high 80 km/hr at a 20-km altitude.

The mass of the moving atmosphere constituting these high-speed winds is several times that of the entire atmosphere. It represents about a quarter of Venus' atmosphere which is about 100 times denser than Earth's.

Despite the scale of these high-speed, upper-level winds, well over half of Venus' tremendously dense atmosphere, near the planet's surface, is almost stagnant. From the surface up to 10-km altitude, wind speeds are only about 3 to 18 km/hr.

In a general way, the high-speed winds can now be explained as due to the transfer of momentum from Venus' slow-moving, massive lower atmosphere to higher altitudes where the atmosphere is less massive, so that the same momentum results in a much higher velocity.

These new discoveries of long-term changes in global wind patterns and an enormous haze envelope which appears and disappears could help scientists further define the "driver" of the planet's high-speed winds. Any future general atmosphere circulation model for Venus will have to produce these long-term changes in wind and cloud patterns.

Details of these and other major findings from the two-year analysis of the Venus cloud and polarimetry data include:

- It is now clear that the high-speed movements of Venus' clouds around the planet are not caused by wave motions in the atmosphere, as was thought by a number of scientists, but are real winds, though there are some wave motions as well. These planet-circling winds, which carry along the clouds, are the same ones which were measured by the four Pioneer Venus probe craft as they descended to Venus' surface in December 1978. These winds blow in an east-to-west direction, circling the planet once every four days at speeds near the equator of 360 km/hr, and near the poles (at around 70 degrees latitude) of 160 km/hr. The Pioneer cloud pictures show the region of Venus' main cloud deck at altitudes between 60 and 65 km above the planet's surface.

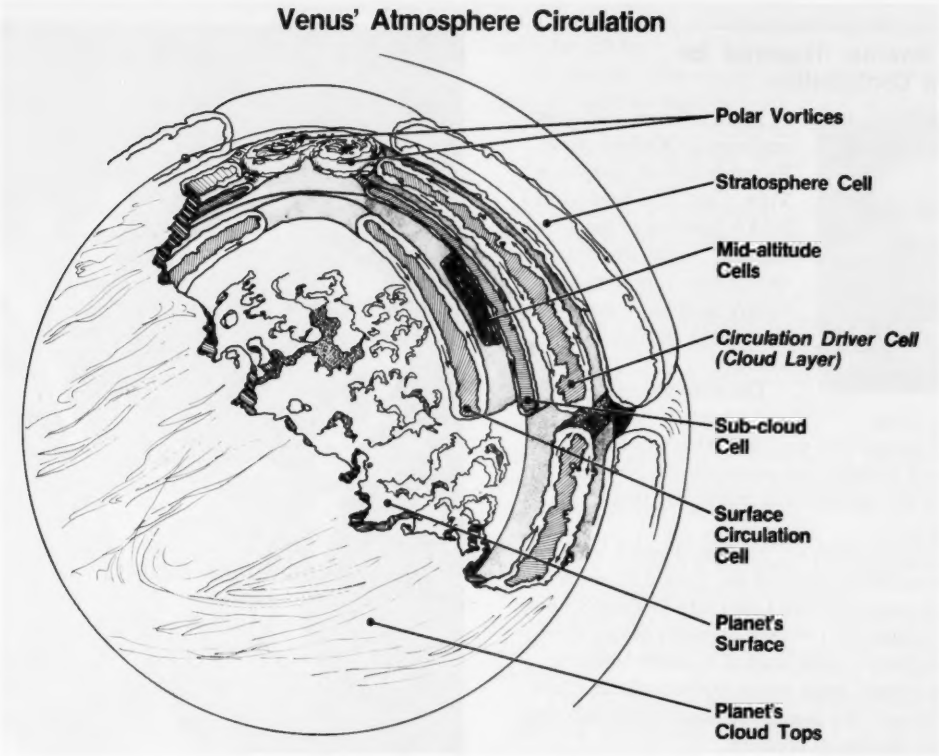
- The global pattern of these planet-circling, cloud-level winds appears to change periodically. For the past two years of Pioneer observations, Venus' clouds and cloud-level winds have been evidencing "solid body" rotation. That is, they move around Venus as though they were made up of one solid, planet-encasing body. This pattern of motion, of course, means wind speeds are much higher at the equator than at the poles.

- However, in 1974 when the Mariner spacecraft flew past Venus, the clouds did not circle the planet as a solid body, and there were mid-latitude jet streams at around 45 degrees latitude. These higher-speed winds had velocities of around 400 km/hr, while wind velocities at the equator were some 40 km/hr lower, at 360 km/hr.

This seems to indicate that there is an irregular cycle of change in the pattern of these cloud-level winds—perhaps several years in length. The duration and rate of change of this cycle of changing wind patterns would be of fundamental interest in understanding the high-speed flow of Venus' upper-level winds around the planet, as well as the behavior of the general atmosphere circulation.

- Measurements of Venus' cloud-level winds show that, in addition to circling the planet, they also blow toward the poles at speeds of around 25 km/hr. These equator-to-pole winds (also seen by the four Pioneer probes at lower altitudes) carry heat from the Sun, absorbed near the Venus equator, to the poles.

The speeds of these equator-to-pole winds agree with the wind measurements by the four Pioneer probes. This indicates that the cloud-level winds are the upper limb of an equator-to-pole Hadley cell



circulation loop, which carries Venus' equatorial heat poleward.

• The so-called global "Y" pattern of Venus clouds with the tail of the "Y" extending eastward around the planet, and the arms westward, appears at times, but is not typical. The "Y" was first seen in ground observations. Sometimes the "Y", which occasionally extends two-thirds of the way around the planet, disappears completely. At other times, it is so changed that it forms a "C" or other shape. In general, the planet shows a whole range of global cloud patterns in addition to the "Y".

• In addition to its well-known veil of clouds, two years of Pioneer polarimetry measurements show that Venus is currently enveloped in an 18-mile-thick blanket of high-altitude haze. The haze is present everywhere, but has about three times more particles per unit volume at the poles than at the equator. At the poles, the haze is so thick that it obscures the base clouds beneath it. This haze of tiny sulfuric acid droplets is the "sealer" of Venus' greenhouse effect, holding additional heat beyond that which would be trapped by the clouds and atmosphere alone. The planet's 482-degree Celsius surface temperature would be somewhat lower without the haze. Furthermore, inclusion of haze effects makes the Venus heat radiation models developed by scientists match the cloud-top atmosphere structure observed by the Pioneer Venus instruments.

Venus' main clouds consist of sulfuric acid particles two microns in diameter, while in the haze layer, the particles are smaller, only a quarter of this size.

Over the next five years of the Pioneer Venus orbiter's extended mission (through 1985), Dr. Travis will be watching the clouds for changes. He will be looking for changes in the global circulation pattern, such as the one which occurred in the five years separating the Pioneer and Mariner missions (1974–1979). Determining such factors as the rapidity of the change and the frequency of its occurrence should lead to further understanding of the Venusian high-speed winds.

The Pioneer Project is managed by NASA's Ames Research Center, Mountain View, Calif. The spacecraft were built by Hughes Aircraft Co.

NASA Inventor Honored for Medical Contribution

Thomas Fryer, a 30-year employee of NASA's Ames Research Center, Mountain View, Calif., has been named NASA Inventor of the Year for 1980. Fryer, who was chosen from inventors at NASA facilities, was cited for his work in medical electronics.

The winning device, completed by Fryer in 1977 and patented in 1980, measures intracranial pressure. Above normal intracranial pressure can cause irreversible brain damage if not detected and relieved by surgery or medication.

Working with NASA's Stanford Biomedical Applications Team and with Dr. Gerald Silverberg, neurosurgeon at Stanford University Medical School, Fryer produced the 1/4-inch-diameter device which can be implanted in the skull of a patient suffering from head injury, brain tumor, hydrocephalus (fluid accumulation in the brain,), stroke or brain infection to monitor changes in pressure.

Past and present devices have had severe limitations. Some have wires which protrude from the patient's scalp. Some leaked, could be damaged by body fluids or posed a risk of infection. Most are not accurate enough for precise medical monitoring.

Because Fryer's detector is small, noncorrosive, accurate, and free of batteries and connecting wires, it may be implanted in the skull for as long as necessary to monitor pressure. Power for the unit is obtained from a small, battery-operated, portable power oscillator placed near the patient's head.

Fryer, an engineer, started with large-scale and semi-miniaturized devices used to measure pressure on air foils in Ames wind tunnels some 10 to 15 years ago. Fryer modified the technology to make it acceptable for human use. He used a miniature titanium pressure cell which can be placed harmlessly in the body and is impervious to body fluids. He mod fied existing detectors to operate without wire (using a capacitance rather than a strain-gauge principle). He reduced the size of existing units by 50 percent.

Most important, Fryer's device will give accurate, stable readings of measured pressure for weeks or months—which had not been possible with previously existing detectors.

The electronic detector and pressure transducer is implanted in the cranium, just under the skin. It has a diaphragm which fits up against the dura (the tough, fibrous outer membrane that envelops the brain), where it can sense even the smallest change in pressure.

Fryer's titanium-based unit was built by Konigsberg Instrument Co. of Pasadena. The detector is being used by neurosurgeons at Stanford University Medical Cetner. Licenses to manufacture the monitors have been given at Pacesetter Systems, Inc., Sylfar, Calif., and Cordis Corp., Miami, Fla.

Howard Honors NASA Official—Isaac T. Gillam, IV, (left), Director of NASA's Dryden Flight Research Center, Edwards, Calif., received an alumni achievement award from Howard University (Washington, D.C.) President James E. Cheek. Gillam was cited for his work in space science and engineering; he earned a bachelor's degree from Howard in 1953.

Lewis Working On De-Icing for Small Planes and Copters

Some three decades ago, NASA helped solve the inflight icing problem for large air transports. Now NASA's Lewis Research Center, Cleveland, has initiated a new assault on one of the last frontiers of all-weather aviation: icing protection for small aircraft and helicopters.

The reasons: The growingly sophisticated general aviation sector with 200,000 planes and some 800,000 private pilots, is being impeded in its operations or, at times, experiencing catastrophe because of icing; and despite the fact that many of its most crucial missions take it into potential icing environments, no U.S.-built helicopter is certified to fly into predicted icing conditions.

Guilding the new program at Lewis is the recently-formed Safety Technology Section headed by John J. Reinmann. It operates as part of the center's Low Speed Aerodynamic Branch under Chief Roger Luidens.

"Our Icing Research Tunnel," says Reinmann, "with its 1.8 by 2.7 meter (6 by 9 feet) test section, is the largest refrigerated wind tunnel in North America. Within it we can duplicate precise inflight icing conditions, study factors that cause icing, and test proposed anti-icing and de-icing systems."

The goal of the Lewis effort is to increase the effectiveness of existing ice protection systems and, concurrently, develop advanced concepts for both anti-icing and de-icing systems that will be reliable, cost-effective, energy-efficient, light in weight and easy to maintain.

Icing occurs almost exclusively between ground level and 6,100 m (20,000 ft). To fly through predicted icing conditions, an airplane must legally be certified to do so by the Federal Aviation Administration. Such certification is earned by having approved ice protection systems on board, and pilots flying into these predicted icing conditions without certification do so illegally.

Today's certified planes employ one or more ice protection systems including, most popularly, pneumatic rubber boots fitted to the leading edges of the wings and ta ls. They are inflated with air after initial ice formationand serve to break up accumulated ice.

Other popular schemes include: routing hot air from the engine to selected aircraft areas where ice builds up; protecting the propellers by electrically-heated boots secured to the blades' leading edges; and releasing liquid antifreeze from the root of the propeller blades.

The growth of the versatile helicopter during the past 35 years has been meteoric and its applications are more versatile today than any other type aircraft.

The helicopter is widely used in business and industry, the military, law enforcement and traffic control, air-sea and wilderness rescue, civilian transport, freight hauling of all kinds, construction, agriculture and in scores of other ways.

Virtually all of a helicopter's missions are carried out well within altitudes where icing occurs. Moreover, its limited fuel capacity restricts its range and its ability to take evasive action from an icing environment.

While all of the vital parts of a helicopter are subject to ice accretion, its rotor blades are most sensitive. The rotor system is a complex, rugged, yet carefully balanced mechanism. Removing ice from the rotor during flight is a difficult undertaking for ice must be removed in a symmetrical fashion so as not to throw the blades out of balance.

Numerous solutions to the icing problem are now under study by the NASA Lewis ice team. They include:

- *The Ice Phobic*: Aviation engineers have long sought an "ice phobic," an agent that has an aversion to ice in much the same way that Teflon and silcones repel various substances.

"Without doubt," says Reinmann, "the ideal anti-icing agent is the 'ice phobic,' one that could be permanently applied to critical surfaces, adding little weight, being low in cost, and never needing replacement.

"The search for that miracle," continues Reinmann, "is a high-risk venture with a high pay-off potential and it is well up on the list of alternatives we are studying."

- *Electro-Thermal*: One method that is currently in use by both planes and helicopters is electrically generated heat. This is now felt to be the most developed of all ice protection ideas under consideration for helicopters.

In use, a network of wires is imbedded in the leading edges of the rotor blades. The system produces sufficient heat to release ice. But to create enough heat to raise blade surface temperature to 40 degrees F requires the output of 25 watts of electricity per square inch of blade surface. That requires a generator equal to the weight of one passenger in a five-passenger helicopter, reducing payload by 20 percent.

• *Pneumatic boots*: Boots are in wide use but their effectiveness is limited. They don't always remove all the ice and they do not, of course, affect ice that has built up aft of the boots. Introduced 40 years ago, the boot has undergone a number of design improvements.

There are numerous other ice protection system possibilities such as mechanical vibrators, oscillators, microwaves and electromagnetic impact, all of which are included in the Lewis program. Attacking icing is—like all problems involving natural phenomenon—a complex venture. It involves meteorology, aviation science and engineering, chemistry, metallurgy, physics, and other fields of study.

Gamma Ray Observatory Instruments Chosen

The scientific instruments which will fly aboard the Gamma Ray Observatory have been selected by NASA's Office of Space Science. The Gamma Ray Observatory is now scheduled for flight aboard the Space Shuttle sometime in 1988.

The instruments selected are:

• Transient Event Montitor—which will detect the short, intense bursts of gamma rays of currently unknown origin, and localize them with sufficient accuracy to determine their distribution in the galaxy.

• High Energy Gamma Ray Telescope—which will measure the energy spectrum and arrival directions of the highest energy gamma rays that can be observed.

• Imaging Compton Telescope—which will provide gamma-ray maps of the celestial sphere at medium energies.

• Low Energy Gamma Ray Spectrometer—which will search the lowest energy gamma ray for spectral features, such as evidence for nucleosynthesis in supernovae.

Studies of gamma-ray sources and gamma-ray production are at the very heart of understanding the dynamics and evolution of stars, galaxies and the universe. Gamma rays are produced in the most powerful processes in the universe, and their high energies qualify them as the most direct probe we have of these processes. A single photon of visible light energy has the equivalent of one electron volt of energy (leV). The gamma rays measured on Gamma Ray Observatory begin at about one hundred thousand electron volts energy (100 KeV) and continue up to several hundred million electron volts energy (100 MeV, or more).

Principal investigators for the four instruments are: Dr. Gerald J. Fishman, Marshall Space Flight Center, Huntsville, Ala., for the transient event monitor; Dr. James D. Kurfess, Naval Research Laboratory, Washington, D.C., for the low energy detector; Dr. Carl Fichtel, Goddard Space Flight Center, Green-

Artist's concept of the Gamma Ray Observatory, the first in a proposed series of missions designed to explore the world of gamma rays—the most energetic form of radiation known to man and to study the high energy nuclear processes. Information returned is expected to provide a much deeper understanding of the nature of supernovas, pulsars, quasars and radio galaxies.

belt Md., Dr. Robert Hofstadter, Stanford University, and Dr. Klaus Pinkau, Max-Planck-Institute Munich, for the high energy telescope; Dr. V. Schoenfelder, Max-Planck Institute, Munich, Dr. John A. Lockwood, University of New Hampshire, Dr. B. N. Swanenburg, University of Leiden, The Netherlands, and Dr. B. G. Taylor, Space Science Department of European Space Agency, The Netherlands, for the medium-energy Compton telescope.

The predecessor spacecraft to the Gamma Ray Observatory are the High Energy Astronomy Observatory-3, which looked at high energy X-rays and low energy gamma-rays, and the Small Astronomy Satellite-2 and the COS-B (a European satellite), which looked at high energy gamma rays.

The Gamma Ray Observatory will be placed into a 400-kilometer high, 28.5-degree inclined circular orbit. It is expected to provide information on gamma rays for two years. It will be one of the largest observatory satellites ever placed in orbit, weighing about 10,432 kilograms and measuring 7.6 meters long and 3.8 m in diameter.

The Gamma Ray Observatory is being managed by Goddard Space Flight Center under the direction of the Office of Space Science.

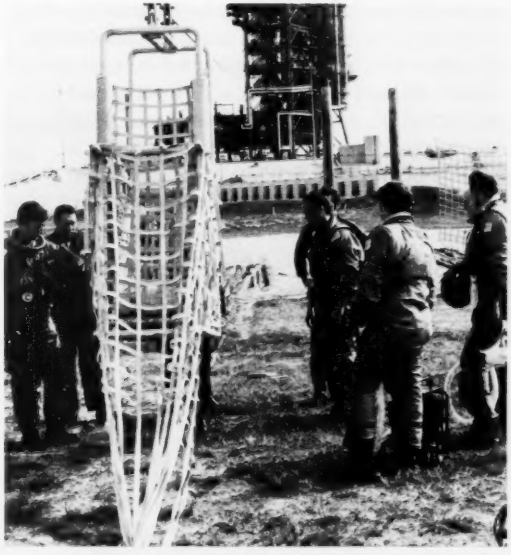
Did You Know?

The Voyager Mission Team represented by Dr. Edward C. Stone, Voyager Chief Scientist, will receive on May 13 the Collier Trophy, the nation's oldest aviation award for an unprecedented level of spaceflight and space exploration achievement, peaking during last year with a highly productive close examination of Saturn, after a comparable visit to Jupiter the previous year.

The Collier Trophy was established in 1911 and is awarded annually by the National Aeronautics Association, administrator of the Trophy, for the greatest achievement in aeronautics or astronautics in America demonstrated by actual use in the preceding year. The Trophy Selection Committee is appointed annually by the NAA president from the nation's distinguished aviation leaders.

James C. Harrington has been appointed to the position of Director, Spacelab Program, NASA Headquarters, effective February 8, 1981. Jim came to NASA in August 1976 from Periphonics Corporation where he served as Vice President, Operations. He has served as Deputy Director, Spacelab Program, since that time. He was formerly Spacecraft Director, Lunar Module (Apollo 12) and Spacecraft Manager, Lunar Module (Apollo 5) at Grumman Aerospace Corporation, Bethpage, N.Y.

Idea Clearinghouse this month cites the ACE (automatic checkout equipment) program at NASA's Johnson Space Center. This program was started by General Electric's Maintenance and Operations to monitor computer errors during spacecraft pad checkout. During simulated operations, computer errors must be detected immediately. The contractor eliminated the need of having someone monitor the console by adding a programmed alarm system. A public address system was added through the intercom box so that detected error signals can be heard throughout the lab. This frees one member of the ACE team for other duties. If you want to learn how the programmed alarm system can be used in your operation, call Mervin Hughes, FTS 525-5228.



Safety baskets—Space Shuttle prime and backup crews and ground support personnel inspect the flat-bottomed baskets used in the slide wire system. This emergency pad-escape system uses five baskets made of Kevlar, a heat-resistant, synthetic fiber. Each can hold up to three persons and is positioned for easy entry in the event of an emergency. The baskets ride on a cable extending from the Fixed Service Structure at the level of the orbiter access arm and descend to a point 1,200 feet to the west of the launch pad.

Contractor News

A.A. Builders of Virginia Inc., Hampton, Va., has been awarded a contract for the rehabilitation of two NASA-Langley Research Center facilities. The $365,000 contract was awarded under Section 8(a) of the Small Business Act of 1953 to renovate the Data Reduction Center and the Flight Control Research Laboratory.

Section 8(a) authorizes the Small Business Administration to enter procurement contracts with federal agencies and, in turn, to subcontract the work to small businesses. The program emphasizes providing subcontracts to businesses owned by socially-or-economically disadvantaged persons. Langley pioneered the Section 8(a) program within NASA by being the first NASA center to enter an agreement with SBA, which was signed in June 1970.

United Technologies Corporation, Pratt & Whitney Aircraft Group, West Palm Beach, Fla., signed a $17,632,950 contract with the NASA Lewis Research Center, Cleveland, to provide eight RL10A-3-3A rocket engines for the Centaur Launch vehicle. The cost-plus-incentive-fee contract is retroactive to August 7, 1980 and continues through September 1, 1983. These engines will be used for missions through 1984. Work will be performed at the contractor's plant in West Palm Beach, Florida. Primary thrust for the Centaur launch vehicle is provided by two Pratt & Whitney RL10A-3-3A engines which develop 33,000 pounds total thrust. These engines are regeneratively cooled and turbopump fed.

Johnson Controls, Inc., Dallas, Tex., has been awarded a $2,642,000 contract by NASA's John F. Kennedy Space Center for an electronic security system. The system will supplement the present protection of the Space Shuttle and its components. The new security arrangements are to include door alarms, motion detectors, video booths to allow verification of personal identity and area authorization before permitting entry, and conversion of the present method of allowing access by badge display to an electronic check of personal identification codes.

Elements of the system will be located on KSC and at Cape Canaveral Air Force Station facilities to protect critical flight hardware and Space Transportation System payload preparation and handling.

Englehard Industries Div., Englehard Minerals and Chemicals Corp., Iselin, N.J., has been awarded a $4,799,000 contract by NASA's Lewis Research Center, Cleveland, to develop and test a fuel-cell-powered energy system. The cost-sharing contract serves as Phase Three of the Full Scale Power Plant Development Program which Lewis manages for the Department of Energy. This program is designed to test the use of fuel cells in a totally integrated energy system which would provide all of the heating and cooling, hot water and electrical needs for a small office building, retail store or apartment building.

Scientific Visit for Prime Minister—Prime Minister Margaret Thatcher of Great Britain (center) received greetings from A. Thomas Young (right), Director of NASA's Goddard Space Flight Center, Greenbelt, Md., and from Dr. Anthony J. Calio, Associate Administrator for Space and Terrestrial Applications, upon her arrival at Goddard Feb. 27. The Prime Minister toured the Operations Control Center and visited the Solar Maximum Mission Project, where a number of British scientists are active participants.

Rockwell International Corp., Space Systems Group, Kennedy Space Center, Fla., has been awarded a contract extension by NASA's John F. Kennedy Space Center for processing Space Shuttle orbiters from launch through landing. The estimated value of the two-year contract extension is $158,760,300. The Space Systems Group at Kennedy was originally awarded a cost-plus-award-fee contract for processing the Shuttle orbiter and its three main engines in January 1977. The contract covers pre-launch, launch, post-launch and landing activities. The contract extension covers the period from April 1, 1980 through March 31, 1982, and brings the cumulative value of the original contract to $285,951,073.

Patents for Inventions from NASA Research

The office of General Counsel, NASA Headquarters, announces that the following U.S. patents have been issued by the U.S. Patent Office to NASA for inventions resulting from NASA research. Inquiries concerning them should be directed to the attention of the NASA Patent Counsel of the indicated installation.

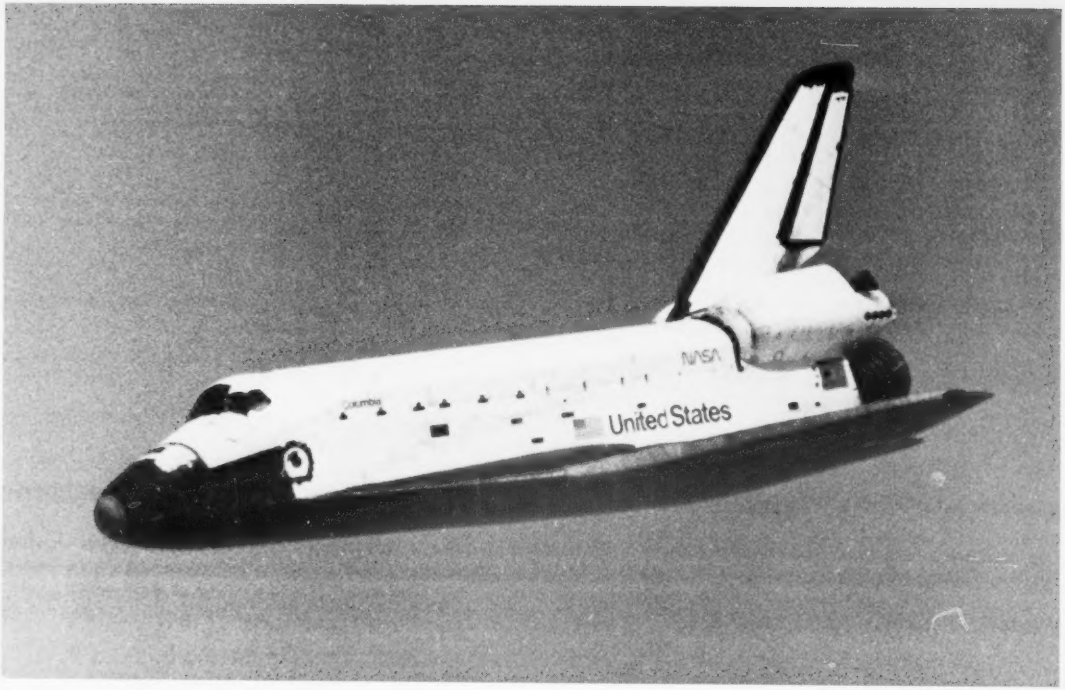
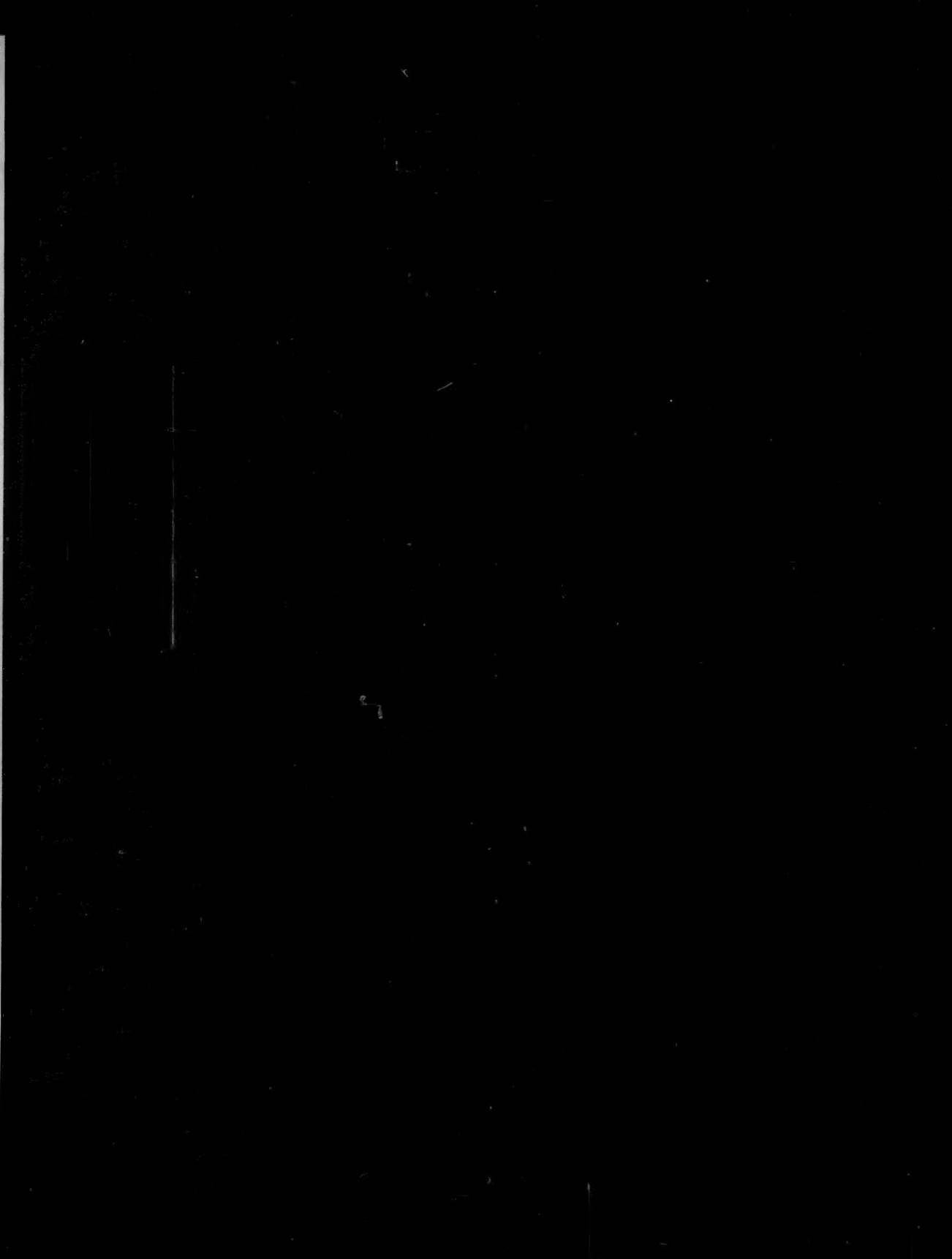
Inventor(s) and Employer	Title	Patent No.	Installation
Harold G. Bush, NASA/LaRC	Lightweight structural columns	4,259,821	LaRC
John M. Hedgepeth, John V. Coyner, Jr. and Robert F. Crawford, Astro Research Corp., Carpinteria, Calif.	Foldable beam	4,259,825	LaRC
Izhak Etsion, Technion Research & Development Foundation, Haifa, Israel	Self-stabilizing radial face seal	4,260,166	LeRC
Antal K. Bejczy, Caltech/JPL, Pasadena	Terminal guidance sensor system	4,260,187	NRO/JPL
Kenneth H. Lambson, Kenneth Lambson & Associates, San Jose, Calif., and Hubert C. Vykukal, NASA/ARC	Spine immobilization apparatus	4,261,349	ARC
Henry F. Tisdale, Sr., Wendell W. Kelley, and Henry F. Tisdale Treasure Island, Fla.	Velocity vector control system augmented with direct lift control	4,261,537	LaRC
William J. Nagle, NASA/LArc	Toroidal cell and battery	4,262,064	LeRC
Warren H. Philipp, Li-Chen Hsu, and Dean W. Sheibley, NASA/LaRC	In-situ cross linking of polyvinyl alcohol	4,262,067	LeRC

Space Shuttle Launches for 1981

Orbiter	Launch Date	Launch site	Payload
OV-102	April 12	KSC	
OV-102	October	KSC	OSTA-1 DFI (with IECM)

Expendable Launches for 1981

Name	Launch Date	Vehicle	Range	Mission Remarks
COMSTAR-D	February 21	Atlas Centaur	ESMC	Comsat General Corp. communications. Reimbursable.
GOES-E	May 14	Delta	ESMC	NOAA weather. Reimbursable.
Intelsat V-B	May 21	Atlas Centaur	ESMC	Intelsat communications. Reimbursable.
Navy 20 (NOVA 1)	2nd quarter	Scout	WSMC	DOD transit. Reimbursable.
NOAA-C	June 22	Atlas-F	WSMC	NOAA weather. Reimbursable.
Intelsat V-C	June	Atlas Centaur	ESMC	Intelsat communications. Reimbursable.
RCA-D	June	Delta	ESMC	RCA communications. Reimbursable.
FLTSATCOM-E	June	Atlas Centaur	ESMC	DOD communications. Reimbursable.
Dynamic Explorer	July	Delta	WSMC	NASA scientific.
SBS-B	August	Delta	ESMC	SBS communications. Reimbursable.
Intelsat V-D	September	Atlas Centaur	ESMC	Intelsat communications. Reimbursable.
Solar Mesospheric Explorer	September	Delta	WSMC	NASA scientific.
Navy 21 (NOVA 2)	4th quarter	Scout	WSMC	DOD transit. Reimbursable.
RCA-C1	October	Delta	ESMC	RCA communications. Reimbursable.
NOAA-D	October	Atlas-F	WSMC	NOAA weather. Reimbursable.
Intelsat V-E	December	Atlas Centaur	ESMC	Intelsat communications. Reimbursable.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